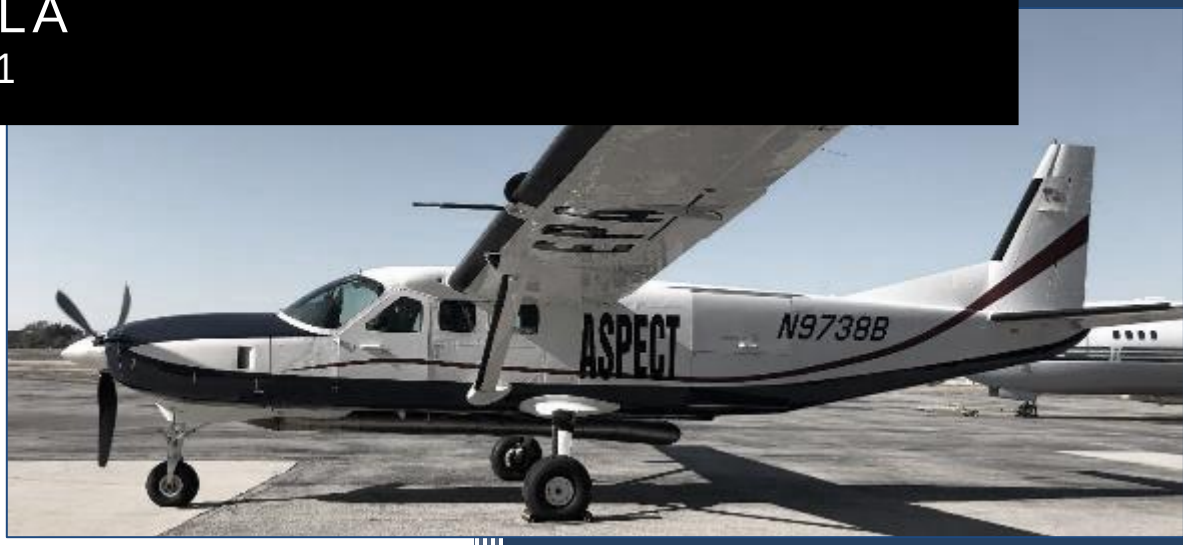
Airborne
Spectral
Photometric
Environmental
Collection
Technology

ASPECT Air Quality Survey Hurricane Ida
Baton Rouge, LA
September 5, 2021



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Acronyms and Abbreviations

Alt	Altitude (in feet)
AGL	Above Ground Level
cm	centimeter
CDT	Central Daylight Time
DEM	Digital Elevation Model
ESF-10	Emergency Support Function #10 – Oil and Hazardous Materials Response
FEMA	Federal Emergency Management Agency
FTIR	Fourier Transform Infrared Spectrometer
FTP	File Transfer Protocol
igm	Spectral data format based on grams format
IR	Infrared
IRLS	Infrared Line Scanner
jpg	JPEG image format
kts	knots
mph	miles per hour
m/s	meters per second
MSIC	Digital photography file from the Imperx mapping camera
MSL	Mean Sea Level Altitude (in feet)
PAN	peroxyacetyl nitrate
Ppm	parts per million
RMP	Risk Management Plan
UTC	Universal Time Coordinated

Executive Summary

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2nd, 2021, the State of Louisiana requested ESF-10 assistance through FEMA and Region 6 asked for the ASPECT plane to be deployed in support of the response to Hurricane Ida. The state wanted assistance monitoring facility emissions in the industrial area between Baton Rouge and New Orleans, where flaring is resulting in the visible emission of black smoke.

ASPECT was tasked to perform remote chemical sensing over target properties to screen for airborne chemicals and take high-resolution photos to provide situational awareness. Potential areas identified for monitoring included: East Baton Rouge, Ascension, Iberville, St. James, St. John, St. Charles, Jefferson, and Orleans. The system conducted one flight mission on 2 September 2021 including air monitoring survey collections over the target area with favorable weather conditions for all passes. Although two black plumes were visible over one of the sites, no major emissions were detected with the FTIR.

A continuation of the overall Baton Rouge facility survey was conducted on September 3. Two data collection flights were conducted which bracketed a Presidential temporary flight restriction not allowing any flight activity. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Flight 5 and 6 were conducted as part of survey operations conducted on September 4. A total of 17 facilities were surveyed. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm in addition to ozone and peroxyacetyl nitrate. Analysis of IR imagery indicated that some facilities are showing hot process units.

ASPECT conducted two data collection missions on September 5 with the focus being facilities in the St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 34 active data collection passes were made covering 26 facilities. Imagery collected within impacted areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

ASPECT Air Quality Survey
Hurricane IDA
Baton Rouge, LA
September 5, 2021

Background and Operational Overview

Hurricane Ida made landfall at 11:55 AM CDT Sunday, August 29 as a high-end category-4 hurricane, with maximum sustained winds of 150 mph. The storm moved ashore near Port Fourchon, Louisiana after a period of rapid intensification, tying for the fifth strongest landfalling continental US hurricane on record with Hurricane Laura of 2020, among three other hurricanes. Severe wind and large-scale flood damage have been reported to property and infrastructure in much of southeast Louisiana, including significant damage in New Orleans, Louisiana. In addition, Ida has caused widespread damage across the Mid-Atlantic and Northeast US.

On September 2, 2021, ASPECT was tasked to conduct a wide area air quality screening level assessment of areas populated with Risk Management Plan (RMP) sites and petrochemical facilities using the ASPECT system for detections of any airborne contaminants from ASPECT's 76 chemical detection library in the areas affected by Ida. The Region wanted to know if any detections were found, the location of the detection, and the concentration detected. Sites including Marathon Petroleum Company, Shell Norco Facility, and Phillips 66 pipeline site were surveyed. There were no chemical detections at the sites surveyed. Extremely slow satellite transmission speeds (possibly due to high bandwidth use by other first responders) resulted in long delays in data collection. Some chemical photos were pulled down during flight, with the majority needing to be pulled down with a more high-speed internet connection on the ground.

On September 3 ASPECT was tasked with a continuation of the general Baton Rouge area survey and conducted two flights. 8 locations in the Baton Rouge area were surveyed as part of two flights. A total of 12 active data collection passes were made covering 8 facilities with no chemical plumes or compounds being detected. Other than flares and isolated steam plumes, little process activity was noted in the data.

Two data collection flights were conducted on September 4 focusing on facilities south of Baton Rouge. A total of 29 active data collection passes were made covering 17 facilities. Analysis of IR imagery indicated that some facilities are showing hot process units. Ammonia was detected and confirmed at a maximum concentration of approximately 14 ppm.

The mission focus for September 5 included a general survey of facilities in St. Bernard, Terrebonne, St. Charles, and St. James. In addition, a request was made to investigate potential oil sheens near Port Fourchon. Targeted facilities are given in Table 1.

Table 1. Sites Covered on September 5, 2021, Flights 7 and 8

Facility	Latitude	Longitude
Cornerstone Chemical Company	29.964722	-90.264722
Chalmette Refining LLC	29.937903	-89.969903
Union Carbide Corp - St. Charles Plant	29.982289	-90.455622
Phillips 66 Co - Alliance Refinery	29.68406	-89.98145
BASF Corp - Zachary Site	29.547603	-90.523231
St Rose Refinery LLC - St Rose Refinery	29.950875	-90.328497
Shell Chemical LP - Norco Chemical Plant West Site	30.004925	-90.422381
Roehm America LLC - MMA Plant	29.9575	-90.265833
Valero Refining - New Orleans LLC - St Charles Refinery	29.985781	-90.3955
Stolthaven New Orleans, LLC - Braithwaite Facility	29.870919	-89.949339
Denka Performance Elastomer LLC	30.053928	-90.524792
DuPont Specialty Products USA LLC - Pontchartrain Site	30.05388	-90.52472
Occidental Chemical Corp - Taft Plant	29.987222	-90.454722
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275
Targa Midstream Services LLC	29.237034	-89.384977
EnLink LIG Liquids LLC - Gibson Gas Processing Plant	29.643056	-90.961944
NuStar Logistics LP - St James Terminal	30.030065	-90.843463
Enterprise Gas Processing LLC - Norco Fractionation Plant	30.015411	-90.402958
Discovery Producer Services LLC - Discovery Paradis Fractionation Plant	29.858889	-90.453333
Plains Marketing LP - St James Terminal	30.004341	-90.848449
Dyno Nobel LA Ammonia LLC - Ammonia Production Facility	29.964789	-90.264625
YCI Methanol Plant	29.97481	-90.86775
IGP Methanol LLC - Gulf Coast Methanol Complex	29.625453	-89.926611
KMe St James Holdings LLC - Methanol Terminal	29.990919	-90.841239
Kemira Chemicals Inc	29.964722	-90.264722
Port Fourchon Oil	29.13349	-90.2018

General Mission Objectives

Once granted access to fly over the sites, the following general mission objectives were employed in conducting data collection with ASPECT:

1. To capture an overall, situational awareness of the incident using aerial photography with:
    - Oblique camera—photos taken by hand from the view/position of the co-pilot, and

- MSIC photos—advanced camera mounted underneath the plane for a top-down view of the designated sites.

2. To qualitatively locate and characterize any the visible and non-visible components of a plume, as well as any areas on fire:
    - Using the Infrared Line Scanner (IRLS)
3. To screen for the presence and location of specific chemicals within ASPECT's automated chemical detection library:
    - Using the Fourier Transform Infrared (FTIR) Spectrometer

Flight Conditions and Status

Weather and Site Conditions

Prior to each flight, an updated status of the current and forecasted weather, site conditions and any potential flight obstacles including radio towers impacting safety is assessed by the crew. A summary of the ground weather conditions during the missions can be found in Table 2 and 3.

Table 2. Ground Weather for Baton Rouge, LA, Flight 7
September 5, 2021

Time	853	953	1053	1153	1253	1353
Wind direction	0 degrees N	270 degrees W	315 degrees NW	0 degrees	270 degrees W	292.5 degrees WNW
Wind speed	0.4 m/s (1.0 mph)	4.0 m/s (9.0 mph)	3.1 m/s (7.0 mph)	1.3 m/s (3.0 mph)	3.6 m/s (8.0 mph)	3.6 m/s (8.0 mph)
Temperature	27.2 C	28.3 C	29.4 C	30.6 C	31.7 C	32.2 C
Relative humidity	91	85	77	72	65	64
Dew point	25.6 C	25.6 C	25.0 C	25.0 C	24.4 C	24.4 C
Pressure	1013.3 mb	1013.6 mb	1013.9 mb	1013.6 mb	1012.6 mb	1011.9 mb
Ceiling	Few 2000 Ft	Scattered 1600 Ft	Broken 1600 Ft	Few 2400 Ft	Few 3400 Ft	Few 4100 Ft

Table 3. Ground Weather for Baton Rouge, LA, Flight 8
September 5, 2021

Time	1453	1553	1653	1753	1853	1953
Wind direction	0 degrees	225 degrees SW	202.5 degrees SSW	202.5 degrees SSW	180 degrees S	180 degrees S
Wind speed	2.7 m/s (6.0 mph)	2.7 m/s (6.0 mph)	3.1 m/s (7.0 mph)	3.1 m/s (7.0 mph)	3.1 m/s (7.0 mph)	1.3 m/s (3.0 mph)
Temperature	27.2 C	27.2 C	27.8 C	27.8 C	26.7 C	24.4 C
Relative humidity	47	46	41	46	51	62
Dew point	15.0 C	14.4 C	13.3 C	15.0 C	15.6 C	16.7 C
Pressure	985.8 mb	985.1 mb	984.8 mb	984.8 mb	984.5 mb	984.5 mb
Ceiling	Clear	Clear	Clear	Clear	Clear	Clear

Data Results

The following data is provided as a summary analysis. All data products are available for the Region to access on a shared FTP site. For a complete list of available products, see Appendix A. The data collected during these missions included a flight path summary, IRLS images, FTIR chemical identification and quantification, high resolution MSIC photos, and oblique photos.

Flight Paths

Wide, slow turns are required to be made in between runs to keep the instruments stable. The blue lines indicate the flight path while the green lines indicate the specific sections of the flight where chemical data was collected and processed. On Flight 7 the Houma and Louisiana coastline areas were surveyed, and on Flight 8 the St. Bernard, Terrebonne, St. Charles, and St. James areas were surveyed. The flight paths are shown in Figures 1 and 2.

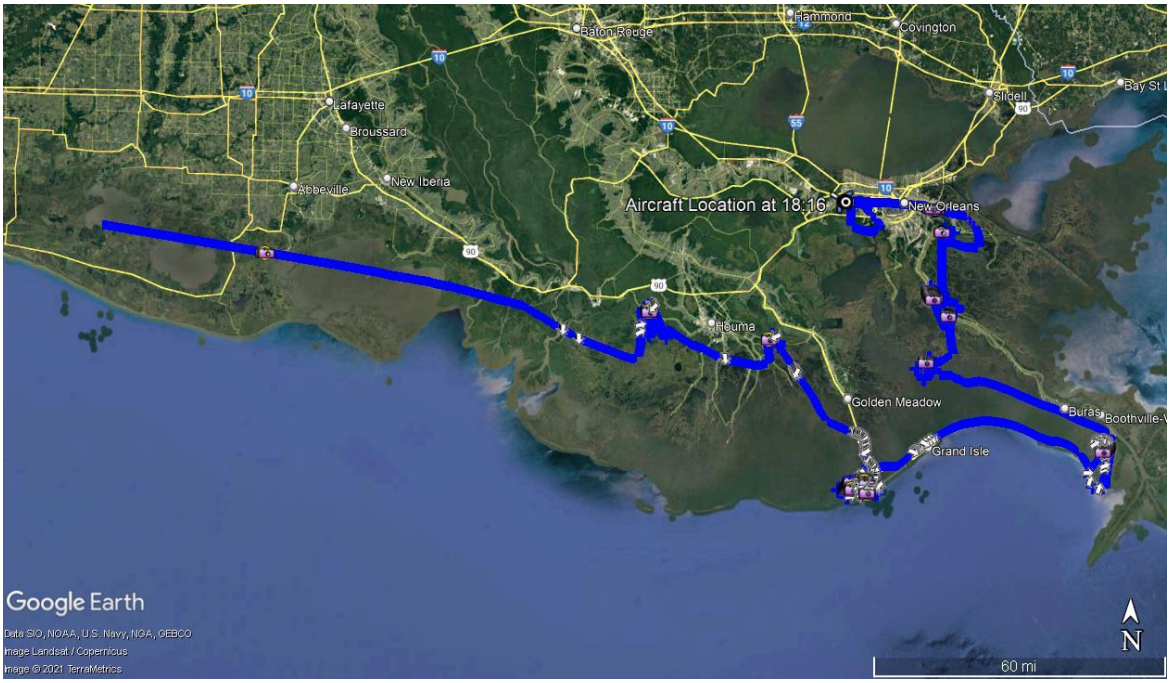

Figure 1. Data Collection Flight Path,
Houma and Louisiana Coastline, Flight 7,
September 5, 2021

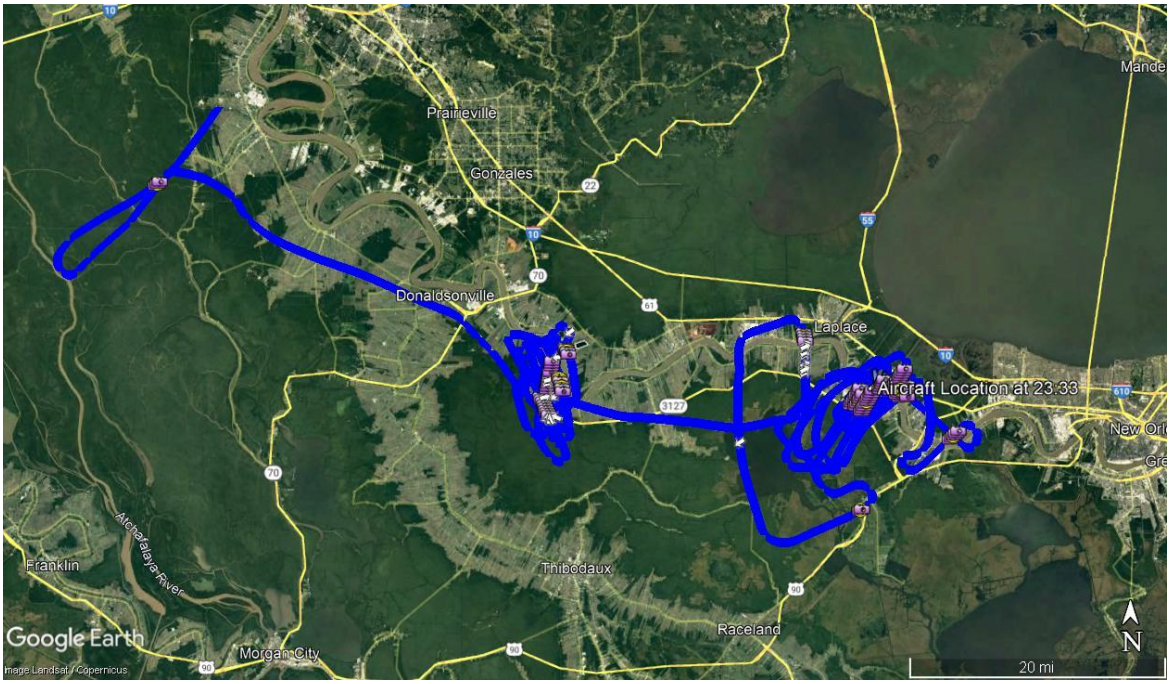

Figure 2. Data Collection Flight Path,
St. Bernard, Terrebonne, St. Charles, and St. James, Flight 8,
5 September 2021

Figure 3 shows a closeup detail of a portion of the mission for Flight 8 showing the flight path of the aircraft, the locations of the aerial photos, the portion of the flight line in which the FTIR was active (green) and the center point of the IRLS image (star).

Figure 3. Detail of the Flight Path Data for Flight 8, September 5, 2021

Line Scanner Data Results

A total of 34 data collection runs were made over the target facilities and an infrared line scanner image was generated for each collection run. Figure 4 shows a 3-band infrared image collected over the Chalmette Refinery. Thermal analysis of the imaged tended to show little with exception of a flare on the bottom of the image. No discharges were observed being emitted from the facility. Figure 5 shows an ASPECT pattern recognition product for oil detection of a light sheen observed near Port Fourchon.

Figure 4. Three band IR image, New Orleans Area, Run 16, Flight 7, September 5, 2021

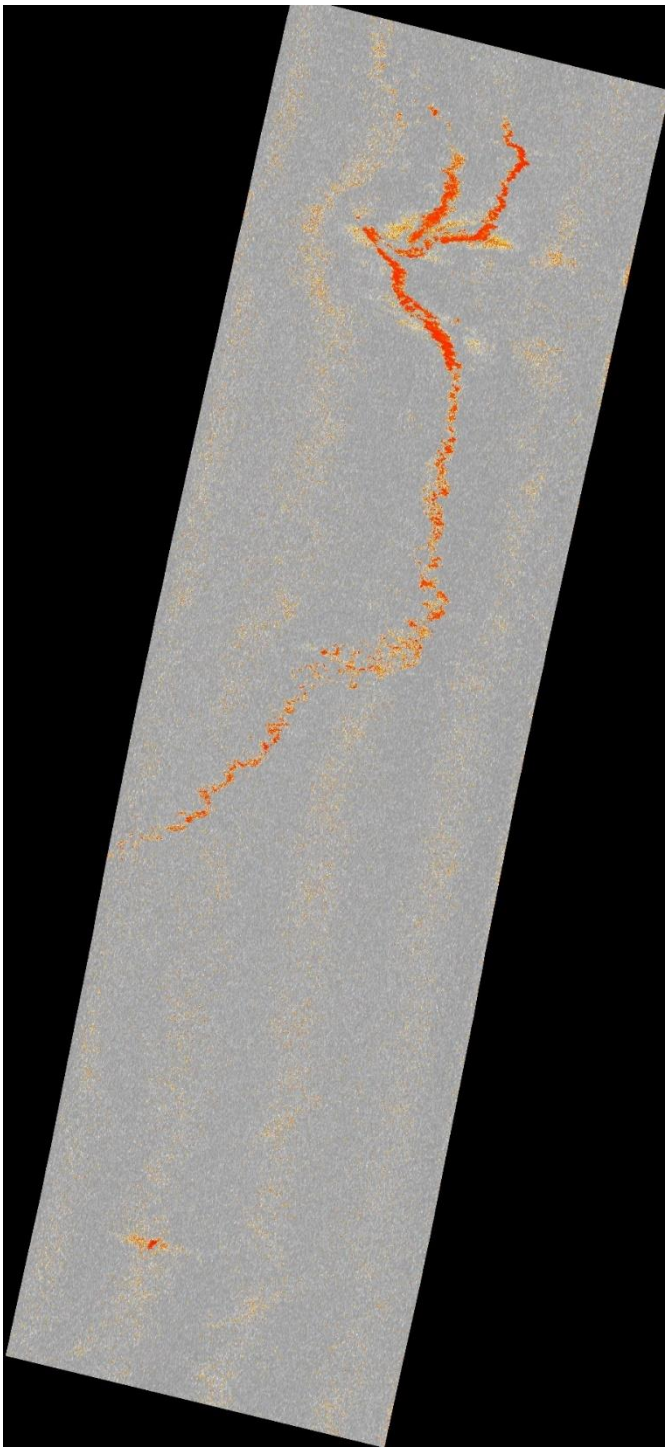

Figure 5. Pattern Recognition Oil Detection Near Port Fourchon Flight 7, September 5, 2021

FTIR Data Results

FTIR spectral data at a resolution of 16 wavenumbers was collected for each run. ASPECT uses an automated detection algorithm to permit compounds to be automatically analyzed while the aircraft is in flight. Seventy-six chemical compounds are included in the airborne algorithm library (the list is provided in Appendix C, Table 1). In addition, collected data was also manually quality checked against a collection of published library spectra for each chemical detected.

ASPECT did not detect any programmed compounds (those found in Appendix C, Table 1) as part of the mission over the target areas on the two flights conducted on September 5, 2021. Details of the monitoring results can be found in Tables 4 and 5.

Table 4. Chemical Results Summary
Houma and Louisiana Coastline, Flight 7

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-05	14:26:39	Test	Test
2		15:05:49	ND	ND
3		15:12:54	ND	ND
4		15:28:49	ND	ND
5		15:49:04	ND	ND
6		15:55:08	ND	ND
7		15:59:39	ND	ND
8		16:06:38	ND	ND
9		16:33:52	ND	ND
10		16:45:19	ND	ND
11		17:05:35	ND	ND
12		17:17:48	ND	ND
13		17:24:43	ND	ND
14		17:33:04	ND	ND
15		17:43:57	ND	ND
16		17:59:09	ND	ND
17		18:15:46	ND	ND

Table 5. Chemical Results Summary
St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 8

Pass	Date	Time (UTC)	Chemical	Max Concentration (ppm)
1	2021-09-05	20:53:57	Test	Test
2		21:11:45	ND	ND
3		21:23:13	ND	ND
4		21:32:39	ND	ND
5		21:40:05	ND	ND
6		21:46:36	ND	ND
7		22:06:58	ND	ND
8		22:20:22	ND	ND
9		22:26:41	ND	ND
10		22:36:04	ND	ND
11		22:45:09	ND	ND
12		22:55:49	ND	ND
13		23:05:37	ND	ND
14		23:13:32	ND	ND
15		23:20:31	ND	ND
16		23:27:24	ND	ND
17		23:32:23	ND	ND

Aerial Photography Results

A full set of high-resolution aerial digital photography were collected as part of each data collection pass. Weather conditions over the survey had some low ceilings but a set of aerial images were collected at each location. Figures 6 shows a representative aerial image collected near Venice, LA. Standing water is present in the secondary containment. Figure 7 shows an oblique image of a damaged oil facility showing what appears to be product within the facility containment structure.

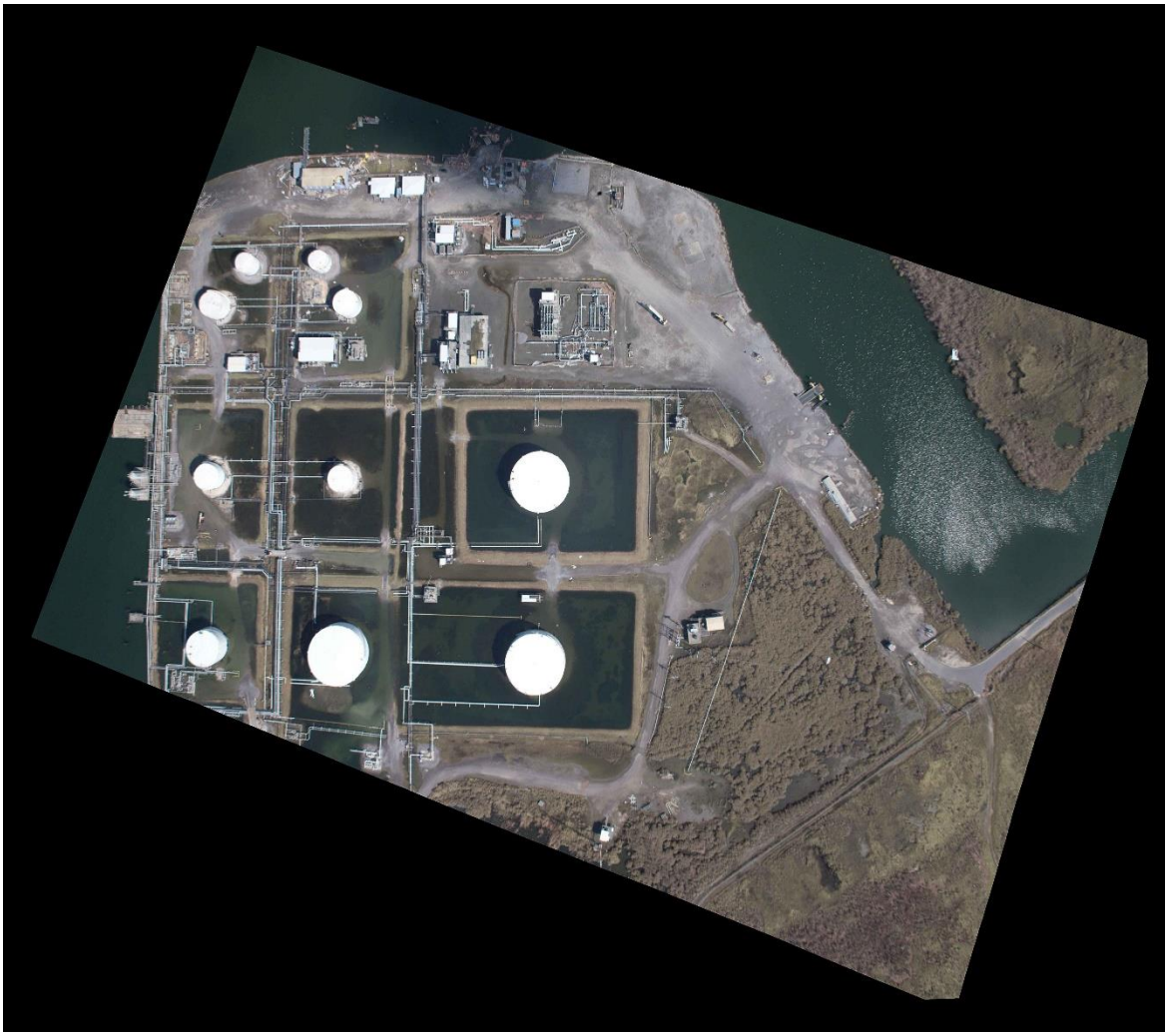

Figure 6. MSIC image of process unit/tank battery near Venice, LA, Flight 7, September 5, 2021

Figure 7. Oblique photo of a damaged oil facility, Flight 7, September 5, 2021

Conclusion

ASPECT conducted two data collection missions on September 5, 2021 with the focus being facilities in the Houma, Louisiana Coastline, St. Bernard, Terrebonne, St. Charles, and St. James areas. A total of 32 active data collection passes were made covering 26 facilities. Imagery collected within impact areas of the storm showed some oil sheen and releases to secondary containment. No compounds were detected on either mission.

Appendix A: File Names of Data Collected During Flight

Houma and Louisiana Coastline, Flight 7, September 5, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	14:26:39	5783	150	20210905142645135.jpg 20210905142651499.jpg 20210905142657848.jpg	20210905_142642_A.igm	2021_09_05_14_26_43_R_01 TA=23.8;TB=44.5;Gain=3	
2	15:05:49	1597	107	20210905150555681.jpg 20210905150558395.jpg 20210905150602030.jpg 20210905150605655.jpg 20210905150609290.jpg 20210905150612925.jpg	20210905_150553_A.igm	2021_09_05_15_05_53_R_02 TA=23.3;TB=43.3;Gain=3	
3	15:12:54	1585	105	20210905151300566.jpg 20210905151304201.jpg 20210905151307836.jpg 20210905151310550.jpg 20210905151314186.jpg	20210905_151257_A.igm	2021_09_05_15_12_59_R_03 TA=24.4;TB=44.2;Gain=3	
4	15:28:49	1547	102	20210905152855666.jpg 20210905152859301.jpg 20210905152902936.jpg 20210905152905666.jpg 20210905152909285.jpg	20210905_152853_A.igm	2021_09_05_15_28_54_R_04 TA=24.9;TB=45.0;Gain=3	
5	15:49:04	1582	102	20210905154909526.jpg 20210905154913161.jpg 20210905154916793.jpg 20210905154920418.jpg 20210905154923148.jpg 20210905154926783.jpg	20210905_154907_A.igm	2021_09_05_15_49_08_R_05 TA=27.1;TB=47.2;Gain=3	
6	15:55:08	1554	110	20210905155514507.jpg 20210905155518126.jpg 20210905155521761.jpg 20210905155525389.jpg 20210905155528119.jpg 20210905155531754.jpg 20210905155535389.jpg 20210905155539008.jpg 20210905155541738.jpg 20210905155545373.jpg	20210905_155512_A.igm	2021_09_05_15_55_12_R_06 TA=25.4;TB=45.4;Gain=3	
7	15:59:39	1582	109	20210905155945966.jpg 20210905155949585.jpg 20210905155952315.jpg 20210905155955950.jpg 20210905155959585.jpg 20210905160003205.jpg 20210905160005935.jpg 20210905160009570.jpg 20210905160013205.jpg 20210905160016824.jpg 20210905160019553.jpg 20210905160023188.jpg 20210905160026808.jpg 20210905160030442.jpg 20210905160034077.jpg 20210905160036806.jpg 20210905160040426.jpg	20210905_155943_A.igm 20210905_160022_A.igm	2021_09_05_15_59_44_R_07 TA=24.6;TB=44.7;Gain=3	
8	16:06:38	1600	109	20210905160644505.jpg 20210905160648125.jpg	20210905_160642_A.igm 20210905_160721_A.igm	2021_09_05_16_06_43_R_08 TA=23.5;TB=43.6;Gain=3	

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9	16:33:52	2982	109	20210905163358700.jpg 20210905163405065.jpg 20210905163411414.jpg	20210905_163356_A.igm	2021_09_05_16_33_57_R_09 TA=24.5;TB=44.5;Gain=3	
10	16:45:19	3026	112	20210905164525989.jpg 20210905164532338.jpg 20210905164538687.jpg 20210905164545052.jpg 20210905164551401.jpg 20210905164557766.jpg 20210905164604115.jpg 20210905164610465.jpg	20210905_164523_A.igm 20210905_164601_A.igm	2021_09_05_16_45_24_R_10 TA=24.5;TB=44.3;Gain=3	
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13	17:24:43	2972	105	20210905172449235.jpg 20210905172455584.jpg 20210905172501949.jpg 20210905172509203.jpg 20210905172515568.jpg 20210905172521917.jpg 20210905172528266.jpg	20210905_172445_A.igm 20210905_172526_A.igm	2021_09_05_17_24_48_R_13 TA=23.8;TB=43.8;Gain=3	
14	17:33:04	2968	107	20210905173310387.jpg 20210905173316752.jpg 20210905173323101.jpg 20210905173330355.jpg 20210905173336720.jpg 20210905173343069.jpg 20210905173349434.jpg 20210905173355783.jpg 20210905173402132.jpg 20210905173408497.jpg	20210905_173307_A.igm 20210905_173346_A.igm	2021_09_05_17_33_09_R_14 TA=27.9;TB=48.0;Gain=3	
15	17:43:57	2927	98	20210905174403166.jpg 20210905174410420.jpg	20210905_174400_A.igm	2021_09_05_17_44_02_R_15 TA=24.0;TB=44.1;Gain=3	
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				20210905181558824.jpg 20210905181605174.jpg			

St. Bernard, Terrebonne, St. Charles, and St. James Areas, Flight 8, September 5, 2021

Run#	Time (UTC)	Altitude (MSL)	Velocity (knots)	MSIC Data Files	FTIR Data Files	IRLS Data Files	Gamma Files
1	14:26:39	5783	150	20210905142645135.jpg 20210905142651499.jpg 20210905142657848.jpg	20210905_142642_A.igm	2021_09_05_14_26_43_R_01 TA=23.8;TB=44.5;Gain=3	
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3	15:12:54	1585	105	20210905151300566.jpg 20210905151304201.jpg 20210905151307836.jpg 20210905151310550.jpg 20210905151314186.jpg	20210905_151257_A.igm	2021_09_05_15_12_59_R_03 TA=24.4;TB=44.2;Gain=3	
4	15:28:49	1547	102	20210905152855666.jpg 20210905152859301.jpg 20210905152902936.jpg 20210905152905666.jpg 20210905152909285.jpg	20210905_152853_A.igm	2021_09_05_15_28_54_R_04 TA=24.9;TB=45.0;Gain=3	
5	15:49:04	1582	102	20210905154909526.jpg 20210905154913161.jpg 20210905154916793.jpg 20210905154920418.jpg 20210905154923148.jpg 20210905154926783.jpg	20210905_154907_A.igm	2021_09_05_15_49_08_R_05 TA=27.1;TB=47.2;Gain=3	
6	15:55:08	1554	110	20210905155514507.jpg 20210905155518126.jpg 20210905155521761.jpg 20210905155525389.jpg 20210905155528119.jpg 20210905155531754.jpg 20210905155535389.jpg 20210905155539008.jpg 20210905155541738.jpg 20210905155545373.jpg	20210905_155512_A.igm	2021_09_05_15_55_12_R_06 TA=25.4;TB=45.4;Gain=3	
7	15:59:39	1582	109	20210905155945966.jpg 20210905155949585.jpg 20210905155952315.jpg 20210905155955950.jpg 20210905155959585.jpg 20210905160003205.jpg 20210905160005935.jpg 20210905160009570.jpg 20210905160013205.jpg 20210905160016824.jpg 20210905160019553.jpg 20210905160023188.jpg 20210905160026808.jpg 20210905160030442.jpg 20210905160034077.jpg 20210905160036806.jpg 20210905160040426.jpg	20210905_155943_A.igm 20210905_160022_A.igm	2021_09_05_15_59_44_R_07 TA=24.6;TB=44.7;Gain=3	

8	16:06:38	1600	109	20210905160644505.jpg 20210905160648125.jpg 20210905160651759.jpg 20210905160655394.jpg 20210905160659031.jpg 20210905160701745.jpg 20210905160705380.jpg 20210905160709015.jpg 20210905160712650.jpg 20210905160715364.jpg 20210905160718999.jpg 20210905160722634.jpg 20210905160726269.jpg 20210905160728983.jpg 20210905160732618.jpg	20210905_160642_A.igm 20210905_160721_A.igm	2021_09_05_16_06_43_R_08 TA=23.5;TB=43.6;Gain=3	
9	16:33:52	2982	109	20210905163358700.jpg 20210905163405065.jpg 20210905163411414.jpg	20210905_163356_A.igm	2021_09_05_16_33_57_R_09 TA=24.5;TB=44.5;Gain=3	
10	16:45:19	3026	112	20210905164525989.jpg 20210905164532338.jpg 20210905164538687.jpg 20210905164545052.jpg 20210905164551401.jpg 20210905164557766.jpg 20210905164604115.jpg 20210905164610465.jpg	20210905_164523_A.igm 20210905_164601_A.igm	2021_09_05_16_45_24_R_10 TA=24.5;TB=44.3;Gain=3	
11	17:05:35	2929	115	20210905170540750.jpg 20210905170548004.jpg 20210905170554369.jpg	20210905_170538_A.igm	2021_09_05_17_05_40_R_11 TA=24.6;TB=44.7;Gain=3	
12	17:17:48	3031	113	20210905171754318.jpg 20210905171801588.jpg 20210905171807937.jpg	20210905_171751_A.igm	2021_09_05_17_17_53_R_12 TA=25.3;TB=45.5;Gain=3	
13	17:24:43	2972	105	20210905172449235.jpg 20210905172455584.jpg 20210905172501949.jpg 20210905172509203.jpg 20210905172515568.jpg 20210905172521917.jpg 20210905172528266.jpg	20210905_172445_A.igm 20210905_172526_A.igm	2021_09_05_17_24_48_R_13 TA=23.8;TB=43.8;Gain=3	
14	17:33:04	2968	107	20210905173310387.jpg 20210905173316752.jpg 20210905173323101.jpg 20210905173330355.jpg 20210905173336720.jpg 20210905173343069.jpg 20210905173349434.jpg 20210905173355783.jpg 20210905173402132.jpg 20210905173408497.jpg	20210905_173307_A.igm 20210905_173346_A.igm	2021_09_05_17_33_09_R_14 TA=27.9;TB=48.0;Gain=3	
15	17:43:57	2927	98	20210905174403166.jpg 20210905174410420.jpg	20210905_174400_A.igm	2021_09_05_17_44_02_R_15 TA=24.0;TB=44.1;Gain=3	
16	17:59:09	2874	112	20210905175915590.jpg 20210905175921955.jpg 20210905175928304.jpg 20210905175934669.jpg 20210905175941025.jpg 20210905175947380.jpg 20210905175953729.jpg 20210905180000078.jpg 20210905180006443.jpg	20210905_175912_A.igm 20210905_175952_A.igm	2021_09_05_17_59_14_R_16 TA=24.1;TB=44.1;Gain=3	

17	18:15:46	2946	107	20210905181551555.jpg 20210905181558824.jpg 20210905181605174.jpg	20210905_181548_A.igm	2021_09_05_18_15_51_R_17 TA=24.8;TB=44.8;Gain=3	

Appendix B: Priority Sites Provided by EPA Region 6 & Louisiana Department of Environmental Quality

Facility_Name	Latitude	Longitude	Parish
Deltech LLC - Baton Rouge Facility	30.552892	-91.200536	East Baton Rouge
ExxonMobil Chemical Co - Baton Rouge Plastics Plant	30.551419	-91.175611	East Baton Rouge
ExxonMobil Baton Rouge Chemical Plant	30.484336	-91.169644	East Baton Rouge
Marathon Petroleum Co LP	30.068394	-90.596364	St. John the Baptist
Westlake Vinyls Co LP	30.209167	-91.017222	Ascension
Valero Refining - Meraux LLC - Meraux Refinery	29.930222	-89.944917	St. Bernard
Cornerstone Chemical Company	29.964722	-90.264722	Jefferson
Chalmette Refining LLC	29.937903	-89.969903	St. Bernard
ExxonMobil Chemical Company - Baton Rouge Chemicals North Plant	30.50465	-91.173219	East Baton Rouge
Equilon Enterprises LLC - Norco Refinery	29.995372	-90.410167	St. Charles
The Dow Chemical Company - Louisiana Operations	30.313927	-91.240586	Iberville
Rubicon LLC - Geismar Facility	30.20139	-91.01222	Ascension
BASF Corp - Geismar Site	30.18425	-91.002778	Ascension
Union Carbide Corp - St. Charles Plant	29.982289	-90.455622	St. Charles
Phillips 66 Co - Alliance Refinery	29.68406	-89.98145	Plaquemines
Axiall LLC - Plaquemine Facility	30.267167	-91.184258	Iberville
ExxonMobil Fuels & Lubricants Co - Baton Rouge Refinery	30.484392	-91.169444	East Baton Rouge
Equilon Enterprises LLC dba Shell Oil Products US - Convent Refinery	30.107684	-90.890796	St. James
Marathon Petroleum Company LP - Louisiana Refining Division - Garyville Refinery	30.061322	-90.593528	St. John the Baptist
BASF Corp - Zachary Site	29.547603	-90.523231	East Baton Rouge
Occidental Chemical Corporation - Geismar Facility	30.18819	-90.98188	Ascension
St Rose Refinery LLC - St Rose Refinery	29.950875	-90.328497	St. Charles
ExxonMobil Chemical Co - Baton Rouge Polyolefins Plant	30.56215	-91.20387	East Baton Rouge
Shell Chemical LP - Norco Chemical Plant West Site	30.004925	-90.422381	St. Charles
NOVA Chemicals Olefins LLC - Geismar Ethylene Plant	30.230619	-91.052884	Ascension
Roehm America LLC - MMA Plant	29.9575	-90.265833	Jefferson
Valero Refining - New Orleans LLC - St Charles Refinery	29.985781	-90.3955	St. Charles
Shell Chemical LP - Norco Chemical Plant - East Site	29.995556	-90.409722	St. Charles
BASF Corp - North Geismar Site	30.20594	-90.99195	Ascension
Stolthaven New Orleans, LLC - Braithwaite Facility	29.870919	-89.949339	Plaquemines
Shintech Louisiana LLC - Shintech Plaquemine Plant	30.273611	-91.173333	Iberville
Denka Performance Elastomer LLC	30.053928	-90.524792	St. John the Baptist

Formosa Plastics Corp Louisiana	30.501722	-91.185944	East Baton Rouge
DuPont Specialty Products USA LLC - Pontchartrain Site	30.05388	-90.52472	St. John the Baptist
Occidental Chemical Corp - Taft Plant	29.987222	-90.454722	St. Charles
Syngenta Crop Protection LLC - St Gabriel Plant	30.246728	-91.103508	Iberville
Mosaic Fertilizer LLC - Faustina Plant	30.083914	-90.91345	St. James
Mosaic Fertilizer LLC - Uncle Sam Plant	30.037222	-90.8275	St. James
LBC Baton Rouge LLC - Sunshine Terminal	30.294444	-91.148333	Iberville
Occidental Chemical Corporation - Convent Facility	30.055885	-90.830594	St. James
TOTAL Petrochemicals & Refining USA Inc - Carville Polystyrene Plant	30.229786	-91.073631	Iberville
Targa Midstream Services LLC	29.237034	-89.384977	Plaquemines
EnLink LIG Liquids LLC - Plaquemine Gas Processing Plant	30.236389	-91.241389	Iberville
EnLink LIG Liquids LLC - Gibson Gas Processing Plant	29.643056	-90.961944	Terrebonne
NuStar Logistics LP - St James Terminal	30.030065	-90.843463	St. James
Enterprise Gas Processing LLC - Norco Fractionation Plant	30.015411	-90.402958	St. Charles
Lone Star NGL Refinery Services LLC - Geismar Fractionation Plant	30.218889	-91.035833	Ascension
INEOS Oxide - A Division of INEOS Americas LLC	30.313889	-91.240278	Iberville
Discovery Producer Services LLC - Discovery Paradis Fractionation Plant	29.858889	-90.453333	St. Charles
Plains Marketing LP - St James Terminal	30.004341	-90.848449	St. James
Methanex USA Services LLC - Geismar Methanol Plant	30.206667	-91.020833	Ascension
Dyno Nobel LA Ammonia LLC - Ammonia Production Facilty	29.964789	-90.264625	Jefferson
Kinder Morgan Liquids Terminals LLC - Geismar Methanol Terminal	30.205389	-91.023792	Ascension
South LA Methanol LP - St James Methanol Plant	30.039917	-90.863819	St. James
YCI Methanol Plant	29.97481	-90.86775	St. James
IGP Methanol LLC - Gulf Coast Methanol Complex	29.625453	-89.926611	Plaquemines
KMe St James Holdings LLC - Methanol Terminal	29.990919	-90.841239	St. James
Kemira Chemicals Inc	29.964722	-90.264722	Jefferson
PHILLIPS 66 PIPELINE LLC	29.923889	-90.482498	St. Charles
CF INDUSTRIES	30.08328	-90.957665	Ascension

Appendix C: ASPECT Systems

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high-speed Fourier Transform Infra-Red (FTIR) spectrometer coupled with a wide-area IR Line Scanner (IRLS). The ASPECT IR systems can detect chemical compounds in both the 8-to-12-micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. List of chemicals and detection limits are listed in Table 1. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) is concurrently operated as part of all chemical collections. These images are often digitally processed in lower resolution, so they can be transmitted via satellite communication. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft. The high-resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available later.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the scientific reach back team. In general, this consists of conducting geo-registration using a USGS Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is check by the team (using a Google Earth base map) for proper location and rotation.

Airborne radiological measurements are conducted using three fully integrated multi-crystal sodium iodide (NaI) RSX4 gamma ray spectrometers. Each RSX4 spectrometer contains four 4”x2”x16” doped NaI crystals each having an independent photomultiplier/ spectrometer assembly. One RSX unit is configured with an additional upward NaI crystal utilized to provide real-time cosmic ray correction. Count and energy data from each crystal and pack is combined using a self-calibrating signal processor to generate a virtual detector output. All radiological spectrometer “packs” are further combined using a signal console controlled by the on-board central computer in the aircraft. Altitude correction data is provided by a radar altimeter with internal GPS systems within the packs serving as a backup. It should be noted that no radiological measurements were conducted on this mission.

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT scientific reach back team for QA/QC analysis. Upon landing, preliminary data results are examined and validated by the

scientific reach back team.

Table 1. ASPECT Automated Compounds

This table contains ASPECT's library of automated compounds.
Detection limits are for each chemical is found in parenthesis in units of parts per million (ppm)

Acetic Acid (2.0)	**Cumene (23.1)**	**Isoprene (6.5)**	**Phosphine (8.3)**
Acetone (5.6)	**Diborane (5.0)**	**Isopropanol (8.5)**	**Phosphorus Oxychloride (2.0)**
Acrolein (8.8)	**1,1-Dichloroethene (3.7)**	**Isopropyl Acetate (0.7)**	**Propyl Acetate (0.7)**
Acrylonitrile (12.5)	**Dichloromethane (6.0)**	**MAPP (3.7)**	**Propylene (3.7)**
Acrylic Acid (3.3)	**Dichlorodifluoromethane (0.7)**	**Methyl Acetate (1.0)**	**Propylene Oxide (6.8)**
Allyl Alcohol (5.3)	**1,1-Difluoroethane (0.8)**	**Methyl Acrylate (1.0)**	**Silicon Tetrafluoride (0.2)**
Ammonia (2.0)	**Difluoromethane (0.8)**	**Methyl Ethyl Ketone (7.5)**	**Sulfur Dioxide (15)**
Arsine (18.7)	**Ethanol (6.3)**	**Methanol (5.4)**	**Sulfur Hexafluoride (0.07)**
Bis-Chloroethyl Ether (1.7)	**Ethyl Acetate (0.8)**	**Methylbromide (60)**	**Sulfur Mustard (6.0)**
Boron Tribromide (0.2)	**Ethyl Acrylate (0.8)**	**Methylene Chloride (1.1)**	**Sulfuryl Fluoride (1.5)**
Boron Triflouride (5.6)	**Ethyl Formate (1.0)**	**Methyl Methacrylate (3.0)**	**Tetrachloroethylene (10)**
1,3-Butadiene (5.0)	**Ethylene (5.0)**	**MTEB (3.8)**	**1,1,1-Trichloroethane (1.9)**
1-Butene (12.0)	**Formic Acid (5.0)**	**Naphthalene (3.8)**	**Trichloroethylene (2.7)**
2-Butene (18.8)	**Freon 134a (0.8)**	**n-Butyl Acetate (3.8)**	**Trichloromethane (0.7)**
Carbon Tetrachloride (0.2)	**GA (Tabun) (0.7)**	**n-Butyl Alcohol (7.9)**	**Triethylamine (6.2)**
Carbonyl Fluoride (0.8)	**GB (Sarin) (0.5)**	**Nitric Acid (5.0)**	**Triethylphosphate (0.3)**
Carbon Tetraflouride (0.1)	**Germane (1.5)**	**Nitrogen Mustard (2.5)**	**Trimethylamine (9.3)**
Chlorodifluoromethane (0.6)	**Hexafluoroacetone (0.4)**	**Nitrogen Trifluoride (0.7)**	**Trimethyl Phosphite (0.4)**
Chloromethane (12)	**Isobutylene (15)**	**Phosgene (0.5)**	**Vinyl Acetate (0.6)**